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curious sp. deemed a garden hybrid produced by *Q. coccinea* and *Q. pinnata,* leaves variously cut few alike, some reniform with shorter cuts, flowers handsome, large purple, tube clavate, limb flat stellate pentagone, stamens exserted. Seen alive in gardens, where sometimes spontaneous."

The *Quamoclita pinnata* Raf. above is certainly *Ipomoea Quamoclit* Linn,. Sp. Pl., 159 (1753), the only pinnate leaved *Quamoclit* known by him at the time, and it is moreover the oldest binary application of the plant under the genus *Quamoclit* antedating Choisy's name *Quamoclit vulgaris*[1] nine years, unless of course one admits the stupid duplicate binaries like *Quamoclit Quamoclit.*

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CROCION ACHLYDOPHYLLUM (GREENE.)

An Ecological and Anatomical Study.

BY R. M. KACZMAREK.

In "Studies in Viola I" in the AMERICAN MIDLAND NATURALIST in the February issue of 1914 we intimated that the presence or absence of cleistogamous flowers in plants in the genus *Viola,* as hitherto held by most botanists, is becoming a recognized character for classification. It was undertaken to segregate the plants of this group taking into consideration their habit and the number of stamens in the so-called "apetalous flowers" when present. On account of these important characters of distinction we proposed the segregates on the basis of this difference.

We proposed the genus *Crocion* Nieuwland and Kaczmarek[2] for the stemmed yellow violets of which *V. pubescens* (Ait.)[3] is the type. In our opinion the western plant confused by botanists under the name of *V. eriocarpa* (Schwein.)[4] is really *V. achlydo-*

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[1] Whether the *Ipomoela Cardinalis* (Cardinal Creeper) offered by A. Boddington, of New York, is the same as *Quamodit Sloteri,* I have been unable to find.

[2] Am. Mid. Nat. III., 8, p. 207-217 (1914).

[3] Ait. Hort. Kew. 3, p. 290 (1789.)

[4] Schwein. Am. Journ. Sci. 5, p. 75 (1822).

phylla (Greene)[1] sufficiently different from the above by its own characters as may be seen by consulting his description. As to the advisability of applying the name *V. eriocarpa* (Schwein.) to the eastern plant even, we would hardly venture too definite a statement as both *V. scabriuscula* (Schwein.), as that plant was formerly known, and *V. pubescens* may or may not have hairy capsules. If the meaning implied in the name is taken as the prime character for substituting the name *V. eriocarpa* (Schwen.) for what was formerly known as *V. scabriuscula* (Schwein.) then one could for the above reason seem scarcely justified in adopting the change.

The use of the name *V. eriocarpa* Schwein., though apparently an older name were scarcely perhaps legitimate because it is not clear that *V. pubescens* variety *eriocarpon*[2] (Nutt. 1818) is not a different plant. If it were a different plant as would seem from the context of Nuttall's description of his plant and Schweinitz' discussion then the latter's name is a homonym. That the plants are not the same might be interpreted from the attempt of Schweinitz to change the name to *V. scabriuscula*. The argument would be therefore that Nuttall's plant is really nothing more than a hairy fruited variety of *V. pubescens*. The following synonomy would show this interpretation of the matter:—

Crocion scabriusculum (Schwein.) Kaczmarek.

V. scabriuscula (Schwein.) T. & G. Fl. N. A. 1 p. 142, (1838).

V. eriocarpa (Schwein.) Am. Jour. Sci. V. No. 1, p. 75 (1822) not *V. pubescens* variety *eriocarpon* (Nutt.) Gen. North Am. Pl. 1. p. 151 (1818).

It has been decided to examine the plant anatomically as well as other plants under the old genus *Viola* to ascertain whether there are any ecological and anatomical characteristics that would distinguish them from one another.

ECOLOGY OF THE SEEDLING.

The ovules are anatropous. The seeds of brownish tint measure about 1–1.5 mm. in width and 2–2.5 mm. in length and contain endosperm. In germination the root first emerges from the seed and then the hypocotyl begins to elongate with the result that the epigeal cotyledons, sooner or later, appear above the surface of the soil, fully expand and begin to perform the functions of assimilation until future foliage leaves appear; then they finally wither and leave two scars in older seedlings opposite the rhizome. This rhizome arises partly from the epicotyl and partly from the hypocotyl. The lower margins of the scars are joined by a shallow line traversing the ventral face of the rhizome. The cotyledons of seedlings examined were more or less, ovate to orbicular in outline with a tendency toward a better development of one half of the lamina. The apices of the cotyledons are notched and a faint yet quite evident mid-rib runs from the apex of the cotyledon to its base. Between the petioles of the cotyledons a very small bud or growing-point pyramidal in shape constitutes the plumule or epicotyl. The plantlet with all the essential organs of vegetation namely primary root (Fig. 1–4, Pr.), hypocotyl (Fig. 1, Hi.), cotyledons with their petioles (Fig. 1, Cot.), and the epicotyl begin subsequent development the rate of which depends upon the appropriation of food entirely from without. Very little food was stored in the cotyledons. Sooner or later after the cotyledons are exposed to the light there are noticeable changes manifested not only in length but also in diameter of all the plant parts. The hypocotyl, however, at first very delicate of nearly equal diameter, begins to expand at the upper extremity gradually tapers as it nears the primary root so that both form a more or less elongated cone with base below cotyledons and apex at the distal end of the primary root. The root soon develops many lateral branches beset with root-hairs. The development of foliage leaves from the tissue of the epicotyl proceeds rapidly (Fig. 3A and B). The leaf originates from the node in the axis between the petioles of the primitive leaves and is then carried upward by the development of the lower internode due to vertical expansion. Later, however, there is in the axis of the raised node another leaf formed which is soon separated from the lastly formed leaf and node by tissue that forms another internode. So there is an internode formed after each successive nodal formation differentiating the stem into nodes and internodes.

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[1] Greene, E. L., Pittonia, 5, p. 87 (1902).

[2] Nutt. Gen. Horth Am. Pl. 1, p. 150 (1818).

The hypocotyl which until now together with the primary root was approximately in the same vertical plane with it, begins to bend upon itself assuming as it does so a more or less horizontal position, dragging toward the ground its apical part. Once under ground the whole of the hypocotyl with a portion of the epicotyl begins a rapid growth in thickness. The increase in thickness is confined chiefly to the region where the hypocotyl becomes continuous with the epicotyl. The former soon begins to produce secondary roots and these are confined mainly to the lower part. With the appearance of secondary roots, the primary root begins to wither or rot and it is represented in seedlings of further development as a black filament or scar (Fig. 2). Fig. 3 A shows what is left of it in the second season of growth.

Although the hypocotyl with that part of the epicotyl that becomes subterranean, assumes a diageotropic position or a position of equilibrium, the primary root maintains and the secondary roots assume a downward growth. It is from this underground diageotropic portion of the seedling that the rootstock develops, the product of the hypocotyl and a part of the epicotyl (Fig. 3–4), the former soon disappearing. If the seed is already underground the hypocotyl when covered with dead leaves or other debris elongates until the cotyledons are exposed to the atmosphere. There are then produced secondary roots from the hypocotyl not far from the cotyledons when the remaining part of the hypocotyl together with the primary root decays. As the plant ages the nodes and internodes become more or less horizontal and give origin to many adventitious roots. The more or less transitional development of the seedling is shown rather clearly in Fig. 1–4.

VEGETATIVE PROPAGATION.

During the spring and early summer of the year 1912 and 1913, while studying the cleistogamous flowers of the violets together with the ecology of seedlings and their structure and the anatomy of mature plants of some of the violets of this region there was found besides some interesting facts regarding the habits and anatomy, one peculiarly characteristic of the plant, namely, that of vegetative propagation. Vegetative propagation, in the sense applicable to this plant and to *Crocion pubescens* (*Viola pubescens* Ait.) is possibly shown by others of the same groups also is although not uncommon nevertheless quite rare in the manner about to be described.

While gathering seedlings of this plant in St. Mary's Ravine, Notre Dame, Indiana, one mile west of the University of Notre Dame, that this fact was first brought to our notice. Seedlings varying with age were gathered and among them were some plantlets the roots of which seemed so old and large as to excite suspicion that they were not real seedlings of the previous season's germination. On tracing the course of the roots it was found that they were those of a central mature plant towards which they radiated inward from all directions. In the majority of cases the plantlets seemed to take origin from roots that had decayed or were decaying and had been severed from the parent plant. Once or twice only was it found that the root that bore a plantlet still had a pronouced communication with the parent, though the region around the origin of the plantlet showed a rather unhealthy condition. This phenomenon, however conclusive called for actual experimentation in order to substantiate former observation in the field.

A number of roots, preference given to those that were fully mature and in normal state of health, taken at random and gathered from many parents not in close proximity were planted in our laboratory in boxes. The greatest precautions were used in taking soil specially sifted and selected so as to exclude seeds of violets. Placed in the light, the ground was kept under conditions of moisture and light as near as possible to those of the natural habits of plants. From time to time the roots were examined to see whether they would show such characteristically localized regions of decay, as seen in those in their natural conditions and surroundings prior to giving rise to young plants. In about three weeks degeneration occurred in the cut ends of the majority. It is from this partially decayed part of the root that a bud soon appeared made up of scales and followed by one or two well developed leaves. This showed conclusively that the violet reproduced new plants vegetatively from old roots.

Among the many parts of seedlings and mature plants brought up in parraffin were included besides the mature healthy roots, roots showing different stages of decay with some bearing plantlets for comparative study of the fibrovascular arrangement and also to investigate the region of plantlet origin. The fibrovascular arrangement was alike in roots showing decay and in those perfectly normal (Fig. 13–14). The plantlets originate from the region surrounding and including the pericycle. The anatomy of these propagated plants was not further studied after determining that they were more or less like seedlings themselves in structure. Fig. 5 shows two old roots severed from the parent, the upper one bearing two young plants one some distance from the other at the distal extremity; the lower one, in which decay took place at the extremity next to the parent, bears but one plant. Study of *Lophion striatum* (*Viola striata* Ait.) seems to indicate that this process of vegetative propagation takes place also from its roots though no experiments were made to determine this beyond doubt. Subsequent observations of yellow violets in the field show that vegetative multiplication is very common in the members of the *Crocion* group.

THE ANATOMY OF THE SEEDLING.

THE PRIMARY ROOT. (*Figs. 6–7*).

In cross section the single vascular bundle (stele, central cylinder) of the primary root (Fig. 6–7) is well marked being of the radial type with leptome (phloem) on either side of the hadrome (xylem). The hadrome arrangement is diarch exarch; that is, the initial hadrome vessels (protohadrome, protoxylem) are found externally to the subsequent hadrome vessels (metahadrome, metaxylem) which are formed centripetally. The first hadrome vessels developed are of the spiral and annular type of small lumen with the former in the majority. The tracheae of the metahadrome though larger in caliber possess the same markings that the initial tracheae. The vascular bundle is limited externally by a single layer of cells, forming a continuous membrane, the pericycle. This is homogeneous, formed of thin-walled flattened parenchymatous cells which are bounded externally by the endodermis which encloses the stele.

There is soon developed from the embryonal meristematic tissue the procambium a region of actively dividing cells the secondary meristem or cambium found between the protohadrome and protoleptome giving rise subsequently to secondary hadrome on the inner side and secondary leptome on the outer side.

The extrastelar fundamental tissue (periblem, primary cortex) is limited internally by the endodermis inclusively and externally by the epidermis exclusively. The endodermis is composed of a single layer of cells which show in cross section suberization along their lateral walls. The endodermis in vertical section is differentiated from the cells within by elongation in the vertical direction and are somewhat narrower than the cells immediately exterior.

The cells composing the periblem are parenchymatous with cellulose walls more or less polyhedral in outline and elongated vertically. In older specimens the cells become more or less irregular in outline with intercellular spaces and contain few starch grains. The hypodermis is composed of a single layer of cells. These differ from the inner cortical layers of cells in having their cell walls thickened and more so on the lateral and external walls. (Fig. 6 Hy.)

The epiblema is composed of a single layer of cells which are somewhat longer anticlinally. The cuticularisation is much more pronounced than in the cell walls of the hypodermis. The epiblema of more advanced primary roots shows quite an amount of cutin on the outer walls of the cells, where it gives rise to a layer of, more or less, equal thickness (cuticle) (Fig. 6–7 Ep.).

THE HYPOCOTYL. (*Fig. 8*).

The cross section of the hypocotyl (Fig. 8) was made a little below the petioles of the cotyledons. The intrastelar tissue although presenting no peculiarities different from those of the well advanced primary root, shows much greater secondary changes. As in primary roots, the protoleptome abutting on the endodermis is still visible though gradually diminishing in size due to the encroachment of the secondary leptome. The proto-and metahadrome vessels are surrounded by secondary hadrome vessels of increasing caliber toward the cortex. The secondary tracheae are mostly of the spiral and more rarely of the scalariform type. The endodermis which is composed of very irregular cells is very distinct. The cortical parenchyma differs in no way from the cells of the periblem of the primary root as to structure but there is a noticeable increase in size of the cells of the former. Chloroplastids are confined chiefly to the layers of the cells exterior to and bordering upon the endodermis and intercellular spaces are scattered throughout the cortex. The cells of the epidermis show a marked cutinization on the lateral as well as outer and inner faces.

COTYLEDONS. (*Fig. 9*).

The petioles of the cotyledons are somewhat flattened along their ventral and dorsal faces. The epidermis is composed of thick-walled cells in which they are anticlinally larger than periclinally. The ground. substance is composed of thin-walled, many-sided, parenchymatous cells rich in chlorophyll and with no intercellular spaces. The chlorophyll is confined mainly to the periphery. The centrally placed fibrovascular bundle is of the collateral type with the hadrome facing the upper or ventral face and the leptome pointing toward the lower or dorsal face.

On either side of the main fibrovascular bundle close to the lateral margins of the petiole and along the same plane are situated, among the parenchyma cells two strands of incomplete wood-bundles (Fig. 9 Vs.).

The cotyledons themselves (Fig. 10–11) in structure are of the bifacial type. In cross section the internal ground-tissue (mesophyll) is composed of thin-walled parenchyma cells of different outline. Just under the upper epidermis (Ep.) there are two rows of more or less elongated cylindrical cells which form a rather compact palisade-tissue; while the cells of the spongy parenchyma, filling the lower half of the ground-tissue, are less regular as to shape and arrangement. Due to this irregularity the intercellular spaces are much larger in the spongy tissue than they are in the palisade tissue, but there is, nevertheless, free passage from the lower to the upper epidermis. All the cells of the ground-tissue are rich in chlorophyll. In the fibrovascular bundles the hadrome (Had.) is placed superiorly next to the palisade tissue with respect to the underlying contiguous leptome (Lep.) next to the spongy parenchyma. The epidermis is composed of thin-walled cells in which different stages of formation of stomata may be observed communicating, when fully developed, with the chlorenchyma by intercellular spaces. (Ep.–Ep'., the former the upper the latter the lower epidermis). A surface view of the epidermis (Fig. 11) shows cells containing many protoplasmic granules confined close to the walls. The elliptical stomata average about 630 μ distant from one another, and the structure of the upper face differs in no essential way from that of the lower. The epidermal cells in surface view range from 315–540 μ in width and from 630–1008 μ in length.

THE EPICOTYL. (*Fig. 12*).

The fibrovascular structure (mestome) of the epicotyl presents characters different from those of the hypocotyl. The mestome is arranged into four, more or less, separate strands of no definite shape with secondary meristem occupying the position between hadrome and leptome forming open collateral vascular bundles. The intrastelar fundamental tissue is composed of thin-walled parenchymatous cells varying in size with no marked elongation in any direction. The tracheae are spiral, annular, and scalariform in type, the last mentioned are only occasionally met with.

The endodermis limiting the stele is much more conspicuous than in the hypocotyl both as to uniformity of shape and to the lateral suberization of the cellwalls which, in cross section, appear as dark spots. The remaining cells of the extrastelar fundamental tissue are thin-walled, polygonal in outline and well filled with starch. There are no intercellular cavities found either in the cortex or medulla. Cutinization is so pronouced in the cells of the epidermis that the cell cavities are remarkably reduced.

ANATOMY OF THE MATURE PLANT.

THE ROOT. (*Fig. 13–14*).

The dermatogen (Fig. 13) is composed of cells which have cuticularised to some extent along the lateral and inner walls and to such an extent along the outer walls that the cuticular membrane so formed becomes stripped off at irregular intervals forming surface projections. The length of the cells is approximately twice their width. The cells of the hypodermis differ in no marked degree from those of the dermatogen in size; their cell walls, however, are not very much thickened. The entire extrastelar groundtissue is composed of rather large polygonal thin-walled parenchymatous cells very much elongated along their vertical axes containing many protoplasmic granules, and an abundance of starch grains which are found as far outward as the epidermis inclusive (Fig. 13 St.). Calcium oxalate crystal aggregates are very common. Two layers of cells next to the hypodermis as seen in longitudinal section (Fig. 14) are from 3 to 5 times as long as broad, the others though of the same width as the former are from 6.5 to 10 times as long. The endodermis though not very distinctive is readily recognized from the rest of the extrastelar fundamental tissue without and from the adjoining tissue within.

The pericycle, well marked in young roots, loses its characteristic appearance partially or entirely, so that it is only occasionally able to be differentiated in older roots. The secondary changes in roots that are quite mature are most evident in the hadrome of the fibrovascular bundle where it occupies the entire central portion of the stele. The larger vessels of the hadrome are mostly reticulately pitted (Fig. 14, 8 and 2) and scalariform pitted (Fig. 14, 1). The articulations of the reticulate vessels where the absorbed transverse walls existed are not uncommonly met with (Fig. 14, 8, 2). The vessels of small caliber are usually of the spiral, reticulate and occasionally of the annular type. Sclerenchymatous tissue (wood-fibres) (tracheids) were always found to be present in old roots. The fibres (tracheids) are about 20 times as long as they are broad, tapering at each end and establishing communications with one another by pits. The leptome is not well developed in which the tubes with rugged walls are from 5—10.5 times longer than they are broad.

The longitudinal section of the old root (Fig. 14) shows these in order from without inward, dermatogen Ep., hypodermis Hy., periblem Cp., endodermis En., pericycle Pe., leptome L., and lastly hadrome H., composed of scalariform pitted (1), reticulately pitted (8–2), spiral (4), and annular (6) vessels, with two strands of wood fibres.(3).

THE RHIZOME. (*Fig. 15–16*).

The cell structure of the epidermis possesses the same external wall thickenings that the dermatogen of the root. Immediately under the epidermis are the cells of the hypodermis which are nearly twice as long as broad and as shown in longitudinal section (Fig. 16) together with the epidermis are being replaced by cork tissue (Co) formed from the newly developed phellogen (Ph). The periderm is composed of thinner-walled parenchyma cells (Phelloderm) toward the inside (not shown in section) and brick-shaped cells with suberized walls in very close union toward the outside separated by the cork-cambium. The outer cortical parenchyma is not as compactly arranged as that nearer the stele. The cells vary in shape not uncommonly isodiametric, and have much starch. The starch grains are found even in the epidermis. The endodermis stands out clearly both in cross and longitudinal sections, differing in no way from that of the root.

The fibrovascular bundles are of the collateral type with hadrome inferior to the leptome the former appearing as a solid hollow cylinder (Siphonostele). The sieve-tubes reach but half the elongation that they do in roots, and are less symmetrical as to their lateral wall arrangement. In cross section the hadrome vessels have a brick-like arrangement, the entire strand of continuous circumference enclosed the central pith. The tracheae though differing in lumen are mostly all of the reticulately pitted type, at times, however, spiral and annular vessels are found. In the rootstock the reticulately pitted vessels are much shorter in length than in roots, with cross wall markings as plainly evident as in the latter. The medula is composed of rather thin-walled cells very rich in starchy deposits. Calcium oxalate crystals are quite abundant in both the intra- and extrastelar fundamental tissues.

THE STEM. (*Fig. 17–18*).

The mestome bundles are open collateral with hadrome endarch tetrarch. The cambium is confined to the bundles between the leptome on the outside and the hadrome on the inside (intrafascicular cambium) being interrupted by the seeming equality of the intrastelar fundamental tissue, in which case the interfascicular cambium (between the bundles) is hardly at all developed constituting, more or less, an interrupted cambium ring. The bundles are more or less circular in cross section. The ducts of the protohadrome are of small diameter mostly annular, and pass gradually to those of the metahadrome and secondary hadrome with large caliber and spiral in type. The scalariform pitted ducts are only occasionally found. The cells of the hadrome parenchyma are thin-walled and elongated along the vertical axis of the stem (Fig. 18 W). The leptome tubes are approximately 10 times longer than broad, of thin walls, and are associated with the companion cells with similar walls attaining but half the length of the cells. The cells of the medulla increase both in width and length as they reach the centre of the cylinder remaining thin-walled throughout their existence. Crystals of calcium oxalate are found within the pith.

The endodermis composed of cells of about the same length as breadth with starch grains limits the stele dipping somewhat toward the medulla between the fibrovascular strands. The cells of the cortical region are all parenchymatous and no sclerenchyma was found. Chlorophyll is confined mostly to the outer cells of the cortex, and small intercellular spaces are present throughout this region. The epidermal and the underlying hypodermal cells, including possibly the cells of the third layer, are much alike as to size, shape and arrangement.

The hairs of the stem are epidermal in origin, confined mainly to the ridges of the stem (Fig. 19 E.), are formed as outgrowths from single superficial cells. In all the hairs examined protoplasm was found to be present containing besides a nucleus with its centrally placed spherical nucleolus, granular deposits (Fig. 19 A.). The hairs, cylindrical in outline with a broad base gradually tapering toward the apex, have their surfaces marked with thickenings obliquely to the vertical axes. (Fig. 19 C.).

LEAF.

PETIOLE. (*Fig. 20–21*).

The petioles in cross section are more or less semicircular in outline. The hadrome vessels are spiral and annular with increasing caliber toward the cortical tissue. The narrow companion cells are scattered among the sieve-tubes with heavy cross walls (Fig. 21). The pith is composed of medium-sized cells with many intercellular spaces. The endodermis in cross sections forms nearly a perfect circumference about the stele, while in longitudinal section the cells differ very much in height and thickness (Fig. 20–21 End.). Chlorophyll is scattered throughout the extra-stelar fundamental tissue as far inward as the endodermis inclusive, with starch grains and calcium oxalate crystals confined mainly to the inner part of cortex. The cortical parenchyma cells increase in size toward the endodermis. The two lateral vascular bundles one on either side of the central bundle possess vessels of the same type as those of the latter, and nothing equivalent to an endodermis sheath.

BLADE. (*Fig. 22*).

The transverse section of the blade (Fig. 22) was made at about the centre of a fully developed leaf. The chlorenchyma is composed of a single layer of palisade cells compactly arranged abutting the upper epidermis, and loosely arranged parenchyma cells next to the lower epidermis, separated from one another by large intercellular spaces. The striking character of the mesophyll is the abundance of chlorophyll. The layers of cells immediately under the upper and lower epidermis, 4 or 5 rows in the former and 1 or 2 in the latter region, at opposite sides of the central bundle, are thick-walled (collenchyma) and usually devoid of chlorophyll. The spongy parencyhma viewed from the lower face has many intercellular spaces (Fig. 23). The central wood-bundle is collateral at the base of the leaf with hadrome next to the palisade tissue, and becomes more or less concentric toward the apex. Cutinization is quite marked in the cells of the lower and upper epidermis. Comparing the face view of the lower and upper epidermis we find that the cell walls of the former are undulate while those of the latter are straight. The stomata, more or less elliptical, are nearly alike as to outline on both faces, those on the lower outnumbering those on the upper face. (Fig. 24–25, upper and lower epidermis respectively).

THE FLORAL LEAVES. (*Fig. 26, a, b, c*).

The hairs are simple formed from single cells in which the external wall protrudes giving the fully developed hairs a characteristic club shape (clavate) (Fig. 26 c). All the hairs are not of equal length, nevertheless all are notably clavate. They were well filled with protoplasm in which many granules were present (Fig. 26 a). The cell wall of the hairs has markings similar to those found on the hairs of the stem (Fig. 26 b). The epidermis even in so delicate a member as a petal has rather thickened cell walls.

The sub-epidermal tissue is made up of thin-walled parenchymatous cells (Fig. 26 a Sub.). The section of the petal was made at right angles to its length in all cases in Fig. 26.

RESUMÉ.

The following facts are characteristic of the plant:—

1. The rootstock is developed from the hypocotyl and part of the epicotyl, some of the former, however, soon disappears.
2. The development of plantlets from old roots by "vegetative propagation" from the region surrounding and including the pericycle. Vegetative propagation was found to be common in the members of the *Crocion* group.
3. In primary roots the plerome, at all times, was diarch.
4. In mature plants the secondary changes are most evident in the hadrome part of the mestome. It is noticeably large and compact in the rootstock and divided with the leptome in the stem into more less distinct strands.

EXPLANATION OF FIGURES.

Fig. 1. Seedling of *Crocion achlydophyllum* (Greene) Nwd. and Kacz., showing secondary brances (Srb.) of the primary root (Pr.), hypocotyl (Hl), petioles (Pet.) and their cotyledons (Cot.).

Fig. 2. Seedling further advanced than in the preceeding figure The primary root is degenerating (Pr.) showing also secondary roots (Sr.), cotyledon scars (Cs.), leaf scars (Ls.) and stipular scales (Ss.).

Fig. 3. Lateral (A) and front (B) view of seedling in the second season's growth. (Pr.) remnant of the primary root, (Sr.) secondary roots, (R. H.) rootstock (rhizome), (C. S.) cotyledon scars, (F.L.) leaf scar (I.N.) first internode, (I.N'.) second internode, (S.S) stipular scales, and (L) young leaf.

Fig. 4. A much advanced seedling showing (L.S.) leaf scars which mark plainly the nodes and internodes of the rootstock. (S.R.) Secondary roots, (C.S.), cotyledon scars and (P.R.) primary root.

Fig. 5. Old roots in the state of degeneration giving rise to plants by "vegetative propagation."

Fig. 6. Cross section of primary root. (Ep.) epidermis, (Hy.) hypodermis, (Cp.) cortical parenchyma, (End.) endodermis, (Pe.) pericycle, (Phad.) protohadrome (protoxylem), (Mhad.) metahadrome (metaxylem), (Lep.) leptome (phloem).

Fig. 7. Cross section of a primary root somewhat advanced in growth showing a fibrovascular supply to a lateral branch (L.B.). (Ep.) epidermis, (End.) endodermis, (Cp.) cells of the cortical region, (P.L.) protoleptome, (Cam.) cambium, (S. H.) secondary hadrome (secondary xylem), (S.L.) secondary leptome (secondary phloem). The protohadrome and metahadrome vessels are represented with heavy dark walls in the centre of the stele.

Fig. 8. Cross section of the hypocotyl. (Ep.) epidermis, (End.) endodermis, (Cp.) cortical parenchyma, (P. Lep.) protoleptome, (Cam.) cambium, (S. Lep.) secondary leptome, (S.Had.) secondary hadrome, (P.Had.) protohadrome and metahadrome vessels, (I.S.) intercellular spaces.

Fig. 9. Cross section of a petiole of a cotyledon. (Vs.) Cells in the state of division to form a vascular strand, one on either side of the centrally placed fibrovascular bundle. (Lep.) leptome, (Had.) hadrome, (Co.) cortical parenchyma, (Ep.) epidermis.

Fig. 10. Cross section of a cotyledon. (Ep.) Upper epidermis, (Pp.) palisade parenchyma, (Sp.) spongy parenchyma, (Ep'.) lower epidermis, (St.) stoma, (Had.) hadrome, (Lep.) leptome.

Fig. 11. Surface view of the epidermis with stomata. Upper and lower faces are alike in all respects.

Fig. 12. Cross section of the epicotyl. (Ep.) epidermis, (Cp.) cortical cells with many starch grains (St.), (End.) endodermis, (Med.) medulla, (Had.) hadrome, (Lep.) leptome, (Cam.) cambium.

Fig. 13. Cross section of an old root. (Ep.) dermatogen, (Hy.) hypodermis, (St.) starch within the cells of the cortex (Cp.), (End.) endodermis, (Lep.) leptome, (Had.) hadrome.

Fig. 14. Longitudinal section of a mature root. (Ep.) dermatogen, (Hy.) hypodermis, (Cp.) cortical parenchyma, (En.) endodermis, (Pe.) pericycle, (L.) leptome, (H.) hadrome composed of scalariform pitted (1),

reticulately pitted (8 and 2), spiral (4) and annular (6) tracheae with two strands of wood-fibres (3).

Fig. 15. Cross section of an old rootstock. (Ep.) Epidermis, (Hy.) hypodermis, (Cp.) cortex cells with starch grains (St.), (End.) endodermis, (L.) leptome, (H.) hadrome, (Med.) pith cells heavily charged with starch.

Fig. 16. Longitudinal section of a rhizome. (Ep.) Epidermis, (Hy.) hypodermis, (Cp.) cortical parenchyma, (E.) endodermis, (L) leptome, (H.) hadrome in which are shown spiral (c), annular (a), and reticulately pitted vessels of large (f) and small(n) lumen, (St.) starch, (Ph.) phellogen and (Co.) cork.

Fig. 17. Cross section of the stem. (Ep.) Epidermis, (Hy.) hypodermis, (Cp.) cortex cells, (End.) endodermis, (Lep.) leptome, (Had.) hadrome, (Med.) medulla.

Fig. 18. Longitudinal section of a stem. (Ep.) Epidermis, (Hy.) hypodermis, (Co.) cortex, (End.) endodermis, (L.) leptome, (H.) hadrome with wood parenchyma (w), (Med.) cells of the medulla in which calcium oxalate crystal aggregates are found (C.R.).

Fig. 19. Hairs on stem. (A.) internal protoplasm with its nucleus (N), nuceolus (O), and protoplasm granules (Pg.), (Cw.) cell wall. Surface view (C.) showing markings (Sm.). The hairs are confined mainly to the ridges of the stem (E.).

Fig. 20. Transvese section of a petiole of a mature leaf. (Ep.) Epidermis, (Hy.) hypodermis, (Co.) cells of the cortex containing calcium oxalate crystals, (End.) endodermis, (Lep.) leptome, (Had.) hadrome, (Med.) medulla.

Fig. 21. Vertical section of the petiole. (Ep.) Cells of the epidermis with thickened outer walls, (Hy.) hypodermis, (Cp.) cortex parenchyma in which chlorophyll (c), starch grains (H.) and crystals of calcium oxalate were found. (End.) Endodermis with chlorophyll, (Lep.) leptome showing sieve-tubes (St.) and leptome parenchyma (Cc.), (Had.) hadrome with spiral and annular vessels.

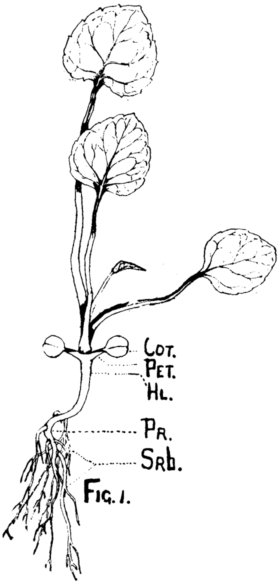
Fig. 22. Cross section of the middle part of a leaf showing the fibrovacular bundle of the midrib. (Ep.) Upper epidermis with the underlying layer of 3 or 4 collenchyma cells, (Ch.) chlorenchyma composed of palisade tissue (Pp.) and spongy parenchyma (Sp.), (Ep'.) lower epidermis and subepidermal thick-angled cells (Col.), (Lep.) leptome and (Had.) hadrome.

Fig. 23. View of the pneumatic tissue of an old leaf from the under face showing its large intercellular spaces.

Fig. 24. Face view of the upper epidermis of a leaf showing the epidermal cells with straight walls and stomata.

Fig. 25. Face view of the lower epidermis of a leaf and stomata. The cell walls of the epidermis are undulate.

Fig. 26. A cross section of the lateral petal cut at right angle to its length. (a) The internal structure and origin of a hair from one of the epidermal cells (Ep.), (Sub.) sub-epidermal tissue, (b) surface view of the hair showing cell wall markings, (c) low power drawing showing the characteristic clavate shape of the hairs.



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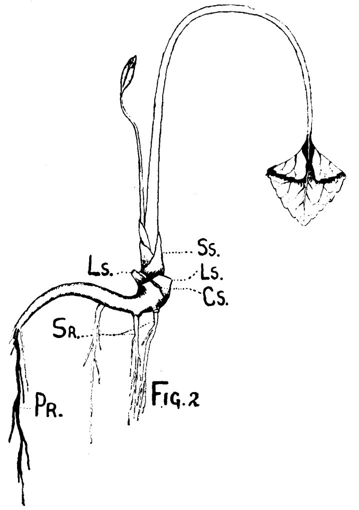


Fig. 2

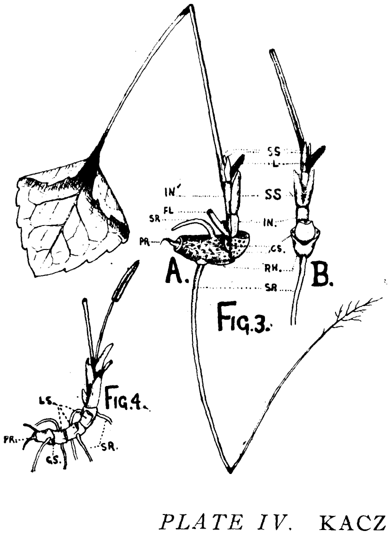


Fig. 3.

Fig. 4.

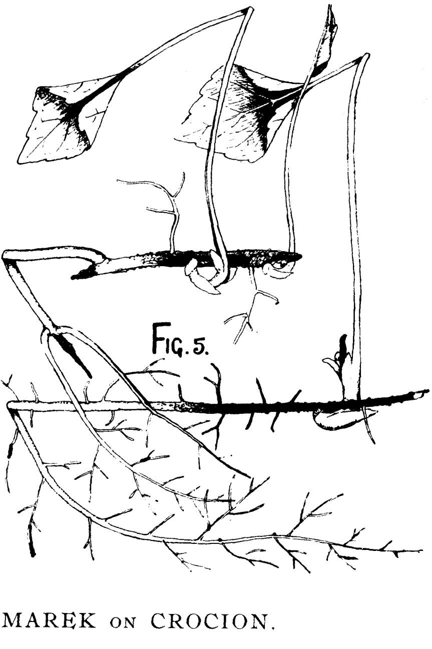


Fig. 5.

PLATE IV. KACZMAREK ON CROCION.

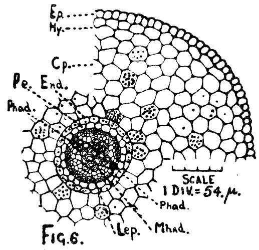
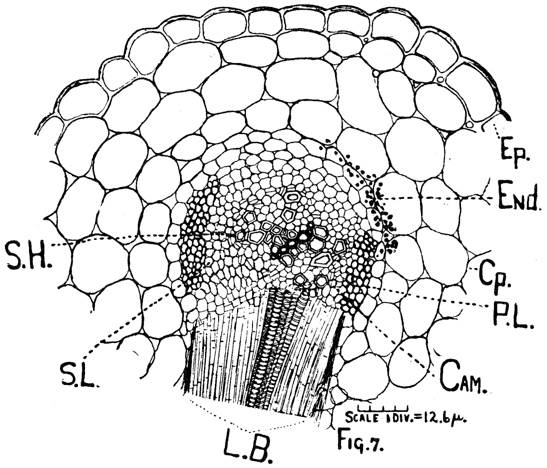


FIG. 6.



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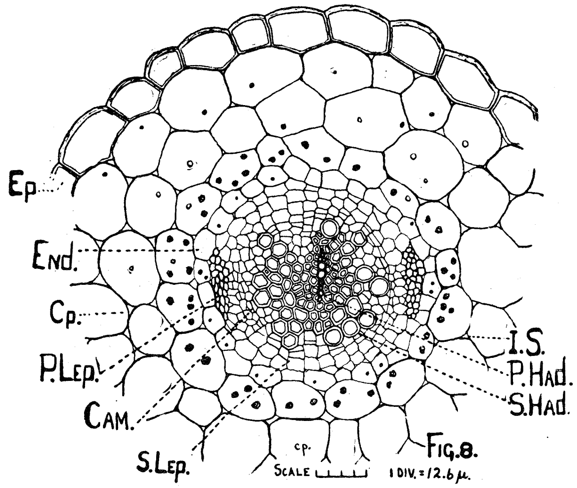


FIG. 8.

PLATE V. KACZMAREK ON CROCION.

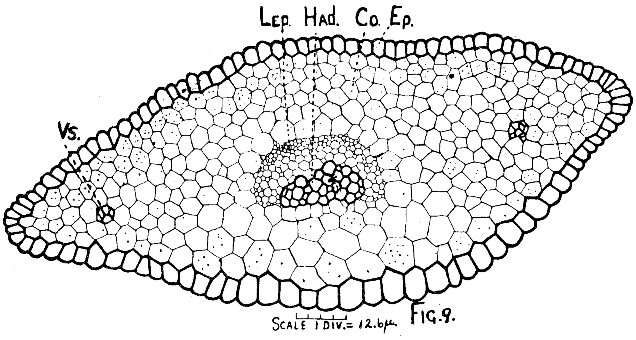


FIG. 9.

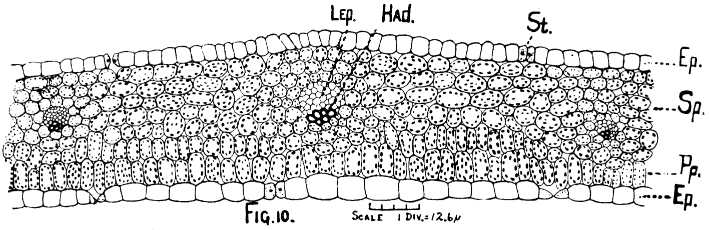


FIG. 10.

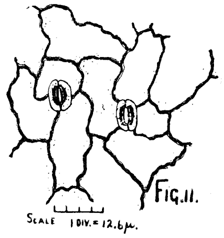


FIG. 11.

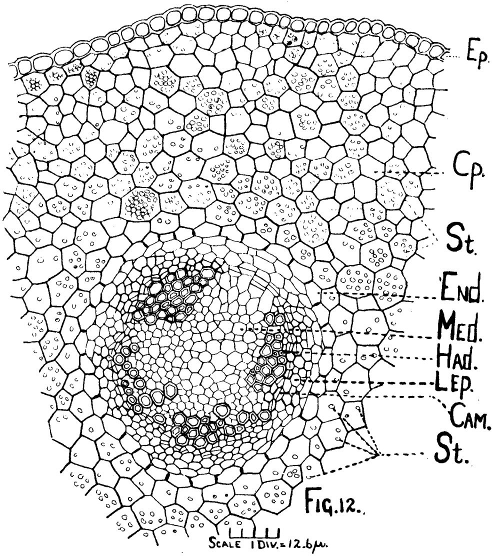
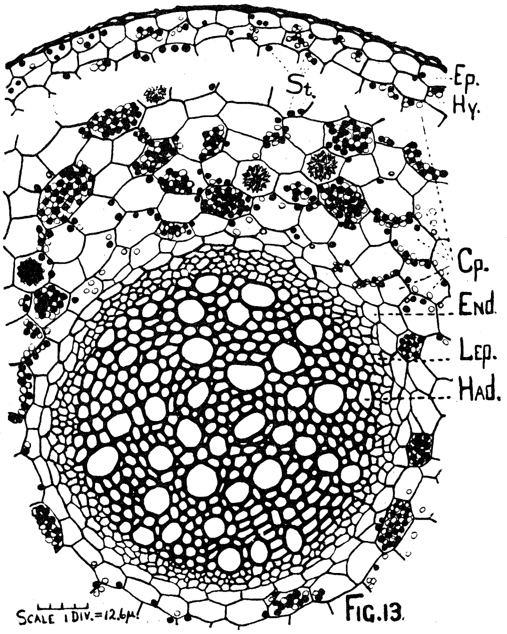


FIG. 12.

PLATE VI. KACZMARĘK ON CROCION.



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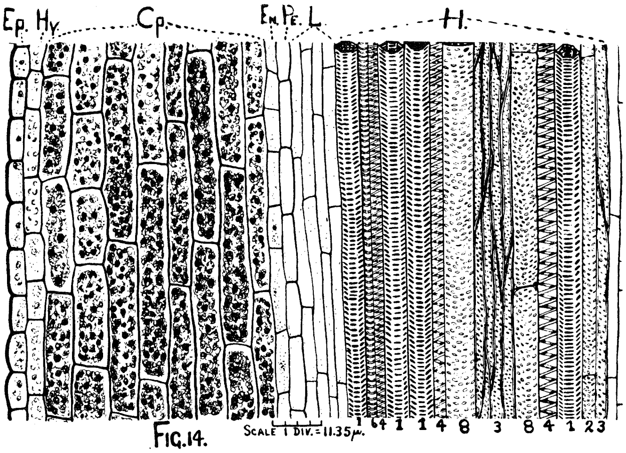


FIG. 14.

PLATE VII. KACZMAREK ON CROCION.

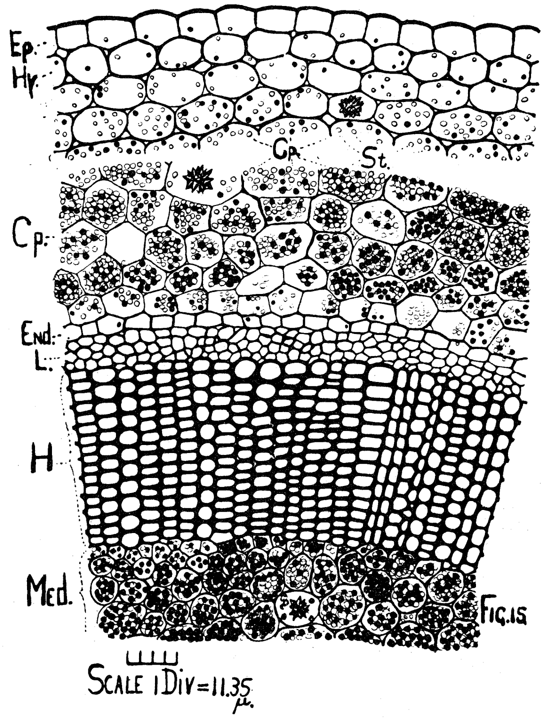


FIG. 15

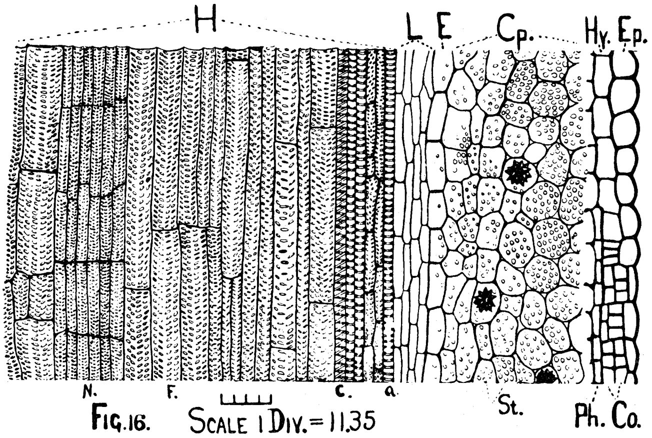


FIG. 16.

PLATE VIII. KACZMAREK ON CROCION.

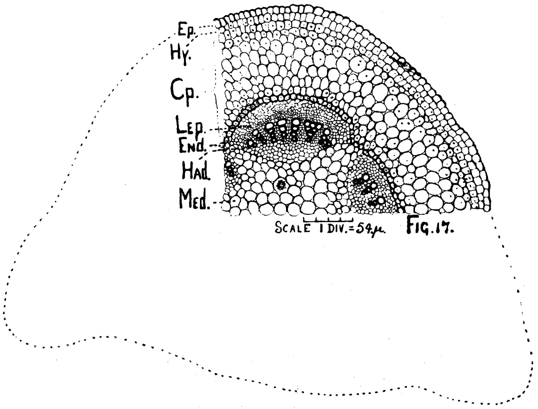


FIG. 17.

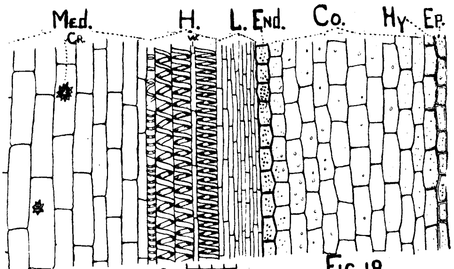


FIG. 18.

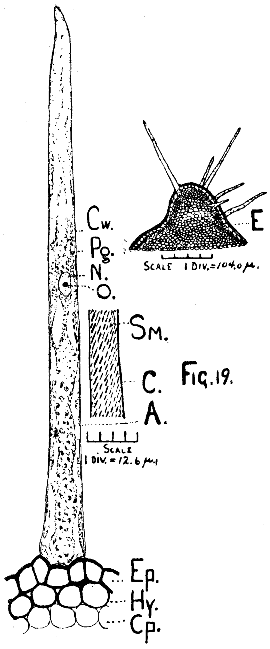


FIG. 19.

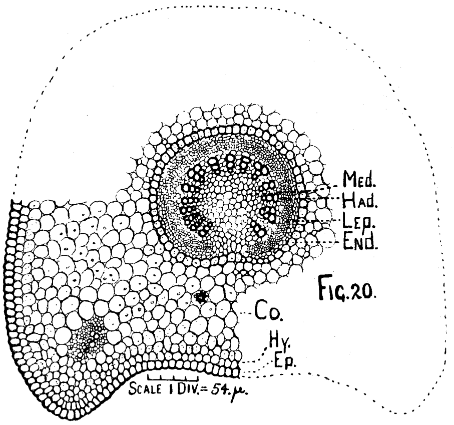


FIG. 20.

PLATE IX. KACZMAREK ON CROCION.

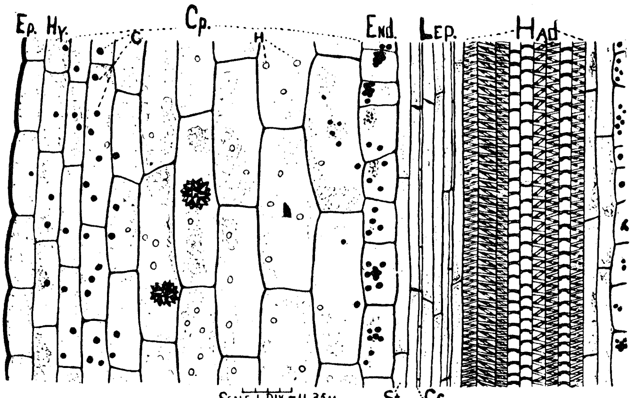


Fig. 21.

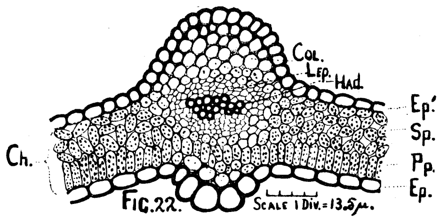
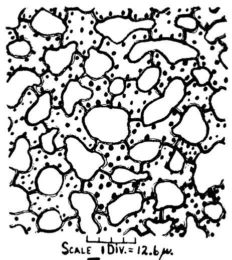


Fig. 22.



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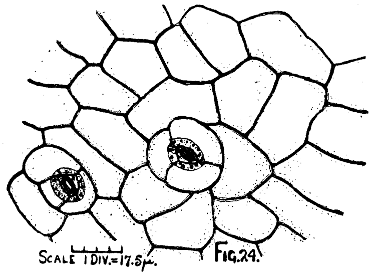
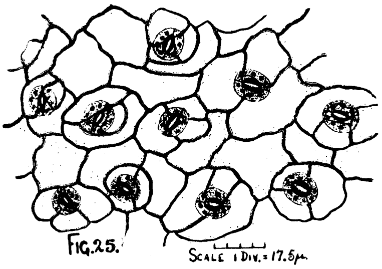


Fig. 24.



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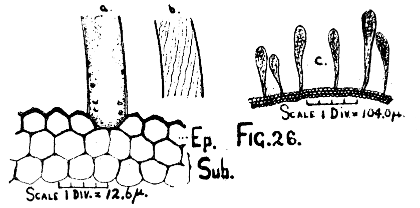

Fig. 26.

PLATE X. KACZMAREK on CROCION.